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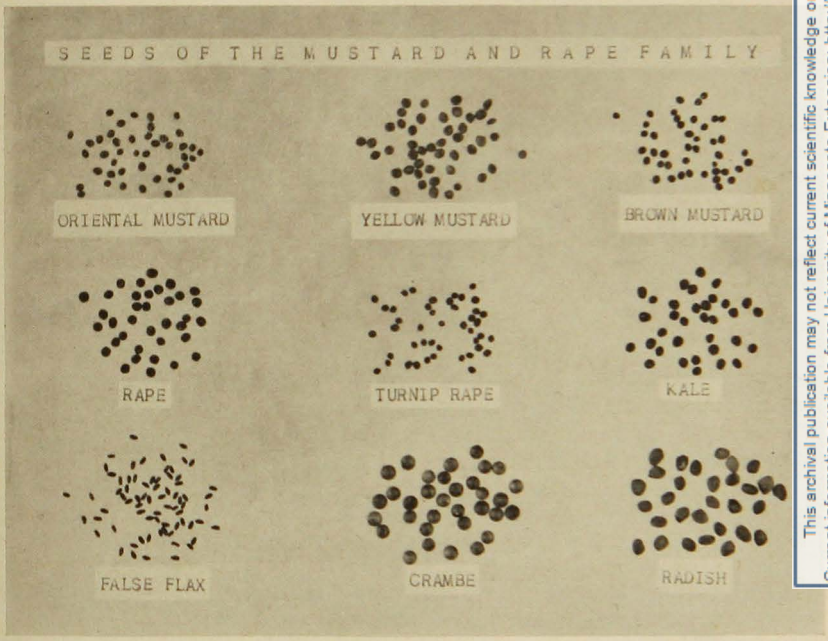

UNIVERSITY OF MINNESOTA
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Mustard And Rape Oilseed Crops For Minnesota

R. G. Robinson

Mustard, rape, and the potential oilseed crops—crambe, false flax, and oilseed radish—are in the mustard family of plants (see cover). These crops have similar soil, climate, and production requirements.

Markets and Potential

Mustard seed is used for oil and table mustard. Before 1962 Montana, California, and foreign countries supplied most of the U. S. demand for mustard. Average yields for 12 years, as shown in table 1, were low. During these same years the United States imported considerably more mustard than it produced. So mustard has not been a surplus crop.

Minnesota production started in 1962; about 25,000 acres were grown in 1963. Two companies and their agents contracted the 1962-63 crops in northwestern Minnesota. Price was about 5½ cents per pound for pure, good quality seed. Processors kept the dockage. Minnesota should be able to maintain high yields at low cost and, therefore, gain a greater share of the U. S. market for mustard.

A few acres of oilseed rape are raised for bird feed and bee pasture. Additional production would have to be sold for oil at a lower price. In Canada, oilseed rape is a major oil crop. Rapeseed delivered to a crushing plant in Manitoba brought 3½ cents per pound in 1963. Minnesota farmers use winter rape as a spring-sown crop in mixture with oats for pasture.

Although rape oil is used as an edible oil in other countries, soybean oil is used here. About 2½ million pounds of rapeseed oil are imported annually for the production of rubber products, lubricants, brake fluids, and other nonfood uses. Rape oil also has potential as a source of erucic acid for industrial products.

Table 1. Average annual harvested acreage, yield, and price of mustard varieties in the United States, 1951-62°

Variety	Acreage 1951-62	Yield per acre 1951-62	Price per pound 1961-62
	acres	pounds	cents
Yellow	20,292	451	6.87
Oriental	13,242	515	4.20
Brown	7,292	524	4.49

° Calculated from USDA Statistical Reporting Service data.

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Figure 1. Left: Yellow mustard. Right: Oriental mustard.

No market now exists for crambe, oilseed radish, or false flax. If industrial demand for erucic acid oils should increase, crambe and radish oil might be used. False flax oil might be used in the drying oil industry. It can be produced cheaply and its drying quality is intermediate between that of linseed and soybean oil.

Farmers should be sure they can sell these crops before growing them.

Yields and Varieties

Comparative yields of crops and varieties of the mustard family are shown in table 2.

Of the four mustard varieties, Yellow *(Brassica hirta)* is the highest yielding and the only one grown commercially in Minnesota. It is used for table mustard. Oriental *(Brassica juncea)* and Brown *(Brassica juncea)* are grown in Montana and used for oil and special mustards (figure 1).

Two species of oilseed rape are grown. Turnip rape *(Brassica campestris)* is smaller seeded and earlier maturing than rape *(Brassica napus)*. Arlo and Polish are the commonly grown turnip rape varieties; Golden, Nugget, and Tanka are the leading

Figure 2. Turnip rape at left is slightly earlier than Yellow mustard at right.

Table 2. Comparison of mustards, rapes, crambe, false flax, and oilseed radish at Rosemount

Variety	Years of trial*	Date first bloom	Date mature	Height	Lodging score†	Bushel weight	Weight of 100 seeds	Oil††	Seed per acre	Fresh seed germination§
		June		inches		pounds	grams	percent	pounds	percent
Mustards:‖										
Yellow	1963	10	July 28	42	7.6	55.5	0.36	24.4	1,206	89
Oriental	1963	15	July 30	51	9.0	53.6	0.22	34.7	934	86
Brown	1963	17	July 31	50	5.3	53.5	0.24	33.0	1,056	58
Seco	1963	17	August 1	54	8.6	.....	0.42	23.9	544	90
Wild (weed)	1963	17	August 1	43	5.6	.....	0.21	30.8	743	0
Turnip rapes:										
Arlo	1960-63	7	July 21	39	4.8	53.1	0.18	37.5	1,135	94
Polish‖	1960-62	6	July 21	37	4.8	52.6	0.19	35.5	1,115	.....
Bele‖	1960, 1962	6	July 20	40	3.8	53.3	0.19	34.9	1,083	.....
Rapes:										
Golden	1960-63	22	August 8	45	4.3	52.1	0.30	38.9	1,061	56
Nugget‖	1962-63	23	August 5	44	3.8	51.3	0.28	37.3	1,053	36
Tanka‖	1963	25	August 11	43	2.9	51.2	0.36	41.9	1,062	84
Regina II‖	1960-62	23	August 9	45	4.8	51.9	0.30	32.7	1,038	.....
Crambe	1960-63	29	August 7	46	5.0	23.9	0.59	33.1	1,362	51
False flax‖	1963	19	July 25	33	2.9	50.2	0.08	32.0	1,392	89
Oilseed radish	1960-63	17	August 20	41	7.0	52.5	0.92	41.9	872	92
LSD (5%)									117	

* Single year data is less reliable than several year data.
† 1 = erect, 9 = flat.
†† Dry matter basis, 1960, 1962-63.
§ Tests made immediately after 1963 harvest. Low germination indicates seed dormancy.
‖ Data adjusted because of missing years so as to be comparable with varieties grown in all trials.

Figure 3. Crambe in seed boll stage.

rape varieties. Arlo originated in Sweden and the three rape varieties in Canada. A new turnip rape variety, Echo, was licensed by Canada in 1964. The names, Polish and Argentine, for turnip rape and rape date from early seed introductions.

Planted acreage of mustard is often much higher than harvested acreage due to abandonment from drought, poor stands, weeds, or insects. Yellow mustard frequently lodges severely. Rape and turnip rape usually stand fairly well (see figure 2).

An important difference between the weed, wild mustard *(Brassica kaber)*, and mustard and rape crops is shown in the last column of table 2. The crops contain little dormant seed. Much of their shattered seed germinates in late summer. In fact, considerable pasture use can be made of volunteer rape. In contrast, wild mustard seed may not germinate for several years.

Crambe *(Crambe abyssinica)* yields more than rape or turnip rape. But harvested seed contains less oil because each seed is covered by a hull. Crambe's two advantages over rape—greater insect resistance and higher erucic acid content of the oil—are offset by disadvantages of more lodging and hull on the seed (figure 3).

Figure 4. Left: false flax. Right: oilseed radish. Crambe shown in foreground is not yet in bloom.

Recent oilseed radish introductions *(Raphanus sativus* and *raphanistrum)* are high yielding but difficult to harvest and thresh. Pods dry slowly and do not break easily.

False flax *(Camelina sativa)* was the best of these crops in yield, lodging resistance, and freedom from insect damage (see figure 4).

Besides the spring-sown varieties of rape and turnip rape, there are winter (biennial) varieties. These do not bloom and produce seed until they have overwintered. Winter varieties bloom in early May, mature early, and escape most insect problems. Trials at several locations in Minnesota indicate that available varieties are not sufficiently winterhardy. In northeastern Minnesota, where snow cover is usually adequate all winter, they sometimes overwinter if planted in early August.

Turnip rape is hardier than rape. Winter varieties are listed in descending order of winterhardiness:

turnip rape—Wilnensis, Rapido II

rape—Tenus, Matador, Dwarf Essex

Dwarf Essex is the variety commonly used as a spring-sown crop in mixture with oats for pasture.

Marrowstem kale *(Brassica oleracea)* is also a biennial used for pasture and silage in Europe. Preliminary tests in Minnesota indicate that it does not provide as early or as long a pasture season as does Dwarf Essex rape. It produces more tonnage if allowed to fully develop. If sown in the spring it supplies pasture in August and September. An advantage claimed for kale over rape for dairy cow pasture is that it does not taint milk.

Whereas the yield of rape is mostly from leaves, kale yield is probably 75-percent stem. The stem grows 2 to 3 inches in diameter and 3 feet high on good soil; it is succulent and palatable.

Imported cabbage worms or cabbage loopers may defoliate kale unless it is sprayed. This insect problem may make the crop uneconomic in Minnesota.

Growing Spring-sown Mustards, Rapes, Crambe, False Flax, and Oilseed Radish

Soil and Climate

These crops require *fertile,* well drained soil. Flooded fields or waterlogged soils generally result in crop failure. On dry sandy soil, performance is usually poor. Plot yields of mustard, oilseed rape, and crambe in 1954-55 on sandy soil in Anoka County averaged under 200 pounds per acre. However, if rainfall is frequent and you use adequate fertilizer you can probably attain good yields on sandy land. In hot dry weather, leaves of these crops wilt long before small grain plants on the same field show injury.

The crops reportedly respond to nitrogen and phosphate fertilizers. Fertilizers such as 23-23-0, 11-48-0, 10-30-0, 24-20-0, and 16-16-8 at rates of 80 to 150 pounds per acre were used on mustard in northwestern Minnesota. Observations indicate that the crops also do well in silt and clay loam soils of *good fertility* without extra fertilizer. Fertilize these crops according to soil test recommendations for small grain.

Mustard and rape can be injured by contact with fertilizer. A greenhouse test showed them to be more

susceptible than wheat, especially on sandy soil. Therefore, use only low rates of fertilizer in drills where both seed and fertilizer boxes empty into the same tubes.

Climatically, these crops are adapted in all parts of Minnesota where small grain is grown. Sunny days and cool nights are favorable. Dry weather at harvesttime is needed.

Crop Sequence and Rotation

Sow rapes or mustard after small grain, flax, corn, potatoes, sugar beets, or fallow. They do well following legumes such as soybeans or field beans but the risk of *Sclerotinia* disease may be slightly greater after these crops than after grains. Fields that are relatively free of perennial weeds, wild mustard, and other problem weeds are necessary. Do not sow rapes or mustards in fields that had rapes, mustards, or sunflowers the previous year.

Crops which can be sprayed with 2,4-D or MCPA should follow rapes or mustards so that volunteer plants from shattered seed can be cheaply controlled. However, if you use mustard and rapes to establish forage crops, volunteer plants will not be a problem.

Rapes and Yellow mustard were good companion crops for alfalfa, red clover, bromegrass, and timothy in 2 years of trial at Rosemount. Turnip rape is probably better than rape because it is earlier, and better than mustard because it is less likely to lodge. All three were better than Garry oats. These trials were sown early so the crops were not competing strongly with the seedings after mid-July. If sown late, they might not be good companion crops because they would compete with seedings in the dry part of the summer. More trials are needed before these mixtures can be generally recommended.

Seedbed and Sowing

Fall plowing and preparation of a good firm seedbed are desirable. Mustard and rape seeds are small. Germination and emergence must be fast and uniform if the crop is to get ahead of weeds. Cultipacking before seeding helps make a firm, even seedbed.

Sow the seed like small grain with a grain drill. A press drill is good for this job. Here are three ways:

1. Some drills can be set for the desired rate. But with many drills the rate cannot be set low enough to prevent sowing too much seed, especially with turnip rape. Therefore, you may have to mix cracked grain with the seed. Take the grain from the hammer mill, clean out the flour and large particles on a fanning mill, and mix medium to small size particles 50-50 with the seed. If you desire a 10 pound per acre sowing rate, calibrate the drill for 20 pounds of the mixture.

Instead of using a seed plus cracked grain mixture in the grain box, some rape growers sow a seed plus fertilizer mixture through the fertilizer attachment. To avoid fertilizer injury, sow about 30 pounds of mixture per acre and mix at the time of sowing.

2. If your drill has a grass seed attachment, you can use pure seed in the grass seed box. However, place the ends of the grass seed tubes into the grain furrow openers. Better stands and more even emergence result if seed is drilled into moist soil rather than broadcast on the surface. If fertilizer goes down the same tubes

as the seed, use low rates to avoid injury in dry soil.

3. A less desirable method is to broadcast and then harrow or disk lightly.

Depth of sowing should generally be 1 inch or less. However, seedlings emerge from 2 inches or deeper if the soil does not crust on top.

Seedlings develop slowly, do not hold the soil as well as small grains, and are easily destroyed by drifting soil. So do not cultipack after planting if wind erosion is likely. If soil drifting threatens to destroy the crop, field cultivate around blowout areas to trap drifting soil. You can spread manure on places where drifting might start.

Time of Sowing

Early sowing gives higher yields (see table 3), but the crop can be killed by freezing. The crop is most susceptible when emerging; later it becomes quite hardy. In 1963 some emerging rape and mustard plants were killed and others injured by 26° F. temperature. A 28° F. temperature 1 month later had no effect on the crops.

Late sowing allows late-germinating annual weeds, such as foxtail, to compete with the crop. Sowing between May 5-20 is best in northern Minnesota; late April or early May is best in southern Minnesota. Early sowing is not so important in northern Minnesota because of cooler summer weather. Some northern Minnesota growers had good results from June and occasionally early July sowings. Unless conditions are ideal, July is too late and frost damage occurs in fall. Sowing in June may be needed for wild oat control on some fields.

Table 3. Effect of sowing date on yields of rapes, crambe, and oilseed radish at Rosemount, 1959-60

Date of sowing	Turnip rape	Rape°§	Crambe	Radish
	pounds per acre			
May 5	1,002	1,305	1,089	1,053
May 19†§	302	.....	1,413	337
June 2	257	347	495	216

° 1960 only.
† 1959 only.
§ Single year data is less reliable than 2-year data.

The trials reported in table 2 were sown May 3, 1960, May 3, 1961, May 2, 1962, and April 13, 1963. Using these planting dates and the "Date mature" column in the table, you can estimate the number of days required for the various varieties to reach maturity for windrowing. For direct combining, several days longer are needed for turnip rape and about 10 days longer for rape and Yellow mustard.

Rate of Sowing

Rate of sowing is not critical if you can obtain a uniform stand (see table 4). In thin stands, individual plants are bigger and branch more than in thick stands. Thick stands may lodge worse than thin stands.

With seed of at least 90-percent germination, sow Yellow mustard at 10 pounds per acre on a good seedbed. Yellow mustard weighs about

Table 4. Crambe, rate of sowing and row spacing comparisons, at Rosemount, 1962°

Rate per acre	Row spacing	Plants per square foot	Yield per acre
pounds	inches		pounds
11	6	15	1,148
16	6	22	1,155
22	6	25	1,086
11	12	13	1,139

° Single year data.

0.4 grams per 100 seeds. Sow the other varieties of mustards, rapes, crambe, and false flax (table 2) at the base rate of 10 pounds per acre of seed weighing 0.4 grams per 100 adjusted for seed weight differences. Refer to column headed "Weight of 100 seeds" in table 2. Turnip rapes weigh about 0.2 grams per 100 seeds; sow them at 5 pounds per acre. Crambe weighs 0.6 grams per 100 seeds; sow it at 15 pounds per acre.

Oilseed radish is an exception to the rule. Sow it at a rate of 5 pounds per acre adjusted upward from the base of 0.4 grams per 100 seeds. Radish is listed in table 2 as 0.9 grams per 100 seeds so sow 11 pounds of it per acre.

Weed Control

Quick and uniform emergence of a good stand of crop is basic for good weed control. Although these crops grow slowly at first, they soon shade the ground and crowd out many annual weeds.

Sow these crops only on land where they can be expected to outgrow weeds. Avoid fields with wild mustard or drainage problems.

For wild oat control, cultivate the land until June and then sow rape or mustard. No herbicides are recommended. DATC (Avadex) and barban (Carbyne) herbicides were effective in trials but have not been registered for rape or mustard by the Pesticides Regulation Division, U. S. Department of Agriculture.

From a mustard marketing standpoint, wild mustard and wild buckwheat are major problems. When these weed seeds are separated from mustard, a large amount of good mustard seed is also removed. So the grower may not be paid for a considerable portion of his crop if it goes into screenings and dockage. In June-planted mustard, much of the smaller mustard seed may be lost in foxtail and pigweed screenings. Companies with specialized machinery, such as electric eye sorters, may buy

Figure 5. Center plot of turnip rape is ready for windrowing.

these almost inseparable mixtures at screening prices.

No herbicides are recommended for controlling weeds in mustard or rapes; 2,4-D injures these crops. Be careful to prevent spray drift injury when spraying nearby grain fields.

Trials of preemergence herbicides from 1959-61 on rapes, crambe, and oilseed radish at Rosemount showed that propazine at 3 pounds per acre killed all crops. Rape, crambe, and especially oilseed radish showed some tolerance to CDAA (Randox) at 4 pounds per acre. Rape and radish showed some resistance to EPTC (Eptam) at 3 pounds per acre. Radish showed tolerance to Amiben at 3 pounds per acre. Other herbicides needing more trial on these crops include diphenamid, trifluralin, and dacthal. Do not use herbicides on these crops until specific recommendations are made.

Harvesting

Ordinary wind, rain, and drying do not make these crops shatter before cutting. But the actual harvesting operation can cause severe shattering losses.

If not weedy, the crops can be direct-combined from the standing crop or windrowed and combined. You may have to windrow rape *(B. napus)* and crambe since stems sometimes remain green long after pods are dry.

For direct combining, wait until the crop is mature and dry. Moisture content above 10.5 percent requires artificial drying for safe storage. The reel may cause shattering. To reduce loss, slow the reel's speed to one-half to two-thirds normal rate. Removing half the bats on the reel also helps reduce shattering. In a heavy stand, the crop may be cut without a reel.

If windrowing, wait until leaves drop and pods and most seeds turn color (see figure 5). Seeds darken and ripen slightly in the windrow. Windrows are bulky and may be scattered by wind. Some Minnesota growers of Yellow mustard built windrow packers. These consist of two 30-gallon steel drums welded together and supported by chains behind and under the windrower (see figures 6 and 7). Bearings on the ends of the pipe through the two barrels allow the barrels to roll easily. Chains support barrels at stubble height so their weight pushes the windrow into the stubble.

Pollination

Mustards and turnip rapes are mostly cross-pollinated. Wind and insects carry pollen from one plant to another. Greenhouse studies (no wind or insects) showed that if turnip rape is not cross-pollinated, only 2 percent of the flowers set pods; cross-pollination resulted in 92-percent pod set.

The blooms attract bees and other insects. High yields obtained in Minnesota fields indicate that pollination by wind and insects is good. However, it may be possible to increase yields by using honey bees.

Rape *(B. napus)* is about 70 percent self-pollinated and 30 percent cross-pollinated. Even if insects and wind are absent, seed is still produced. However, Russian workers reported yield increases due to the presence of honey bees.

These crops compete with alfalfa and clover for insect pollinators. If mustard, rape, and sunflower acreage continues to increase in northwestern Minnesota, more bee pasture will be

Figure 6. Barrel windrow-packing attachment on windrower.

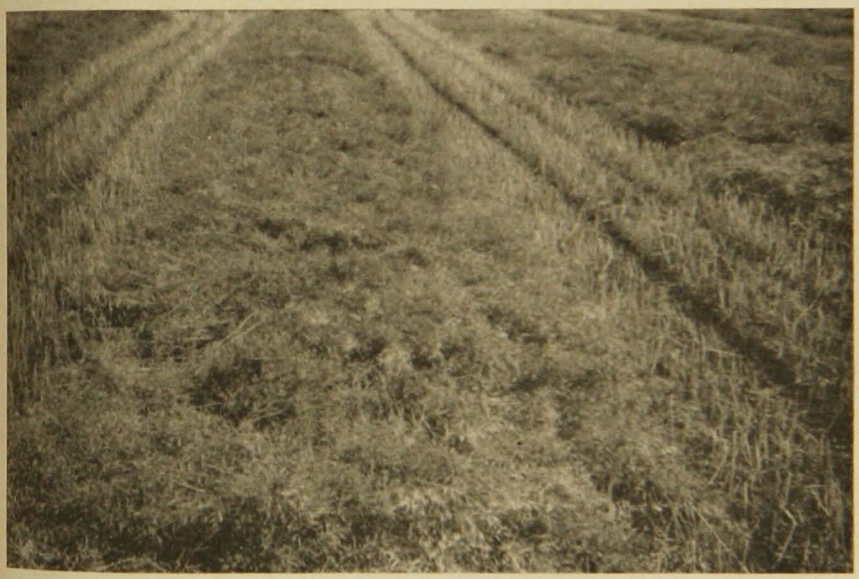

Figure 7. Windrow packed with barrel attachment.

available from July through September. Rape honey has slightly less flavor and granulates more quickly than clover honey. It is reportedly unsatisfactory for overwintering bees because it granulates too firmly. Processors may blend rape and clover honeys to make a firm honey that still spreads easily.

Insects

Insects are a major pest on mustard and rape so plan on spraying. Unfortunately, few insecticides are registered for use on these seed crops by the USDA. However, a recent opinion from the Pesticides Regulation Division permits using the same insecticides for mustard seed production that are now approved for mustard greens.

Therefore, you may use the following insecticides on mustard with indicated waiting periods between application and harvest: aldrin, 14 days; dibrom, 4 days; dieldrin, 21 days; malathion, 7 days; methyl parathion, 21 days; parathion, 10 days; phosdrin, 3 days; or sevin, 14 days. Do not use DDT, lindane, or toxaphene after the seedling stage.

Other rulings may be made so follow official recommendations. On contracted acreage, follow directions of the contracting agent in spraying.

Limit insecticide applications to those registered by the USDA Pesticides Regulation Division.

Fleabeetles, cutworms, and the red turnip beetle attack young seedlings. Fleabeetles and turnip beetles also feed on pods. The larvae of the diamondback moth, beet webworm, bertha armyworm, and imported cabbage worm attack from the bud stage until maturity.

Fleabeetles and diamondback moth caterpillars have been the most troublesome insects. Fleabeetles are shiny, black, jumping beetles about one-eighth inch long. They eat small round holes in leaves and feed on pods. They do not attack crambe. Fleabeetle injury to young seedlings has been prevented by treating seed with approved insecticides like lindane. Later infestations on mustard may be controlled with sevin or malathion. Diamondback moth caterpillars grow to one-half inch long and are colorless to green colored worms. They eat leaves, flowers, and green pods and are extremely active when touched. Methyl parathion, dibrom, or sevin is suggested for control of diamondback moth larvae in mustard.

See Minnesota Extension Bulletin 263, *Insecticides and Their Uses in Minnesota*, for further information.

Clean sprayers which have been used for 2,4-D before using them to spray insecticides on these 2,4-D-susceptible crops. Rinse the sprayer thoroughly with water. Refill the tank and add 1 quart of household ammonia per 25 gallons of water. If esters or brushkillers were used in the sprayer, also add 2 gallons of fuel oil or kerosene per 25 gallons of water. Run the pump. Open the boom valve and spray for a few minutes. Shut off and let stand overnight. Drain the sprayer and rinse with water. If available use hot water for all rinsings.

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